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International Application No.
Demande internationale n° PCT/IB03/04771

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(28.10.03)

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(08.06.04)

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The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty

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PCT/IB 03/04771
International Application No.

28 OCTOBER 2003 (28.10.03)
International Filing Date

INTERNATIONAL BUREAU OF WIPO
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference (if desired) (12 characters maximum) 21006426

Box No. I TITLE OF INVENTION

AUDIO BLOCK

Box No. II APPLICANT ☐ This person is also inventor.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

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Sheet No. 1a

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- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

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See Notes to the request form

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	Where earlier application is: regional application:* regional Office	Where earlier application is: international application: receiving Office
item (1)				
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

** Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* . . . .

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA / SE

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

Date *(day/month/year)*	Number	Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*:		Number of declarations
☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

See Notes to the request form

Sheet No. 4

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:

(a) in paper form, the following number of sheets:

request (including declaration sheets)	: 5
description (excluding sequence listings and/or tables related thereto)	: 18
claims	: 3
abstract	: 1
drawings	: 10
Sub-total number of sheets	: 37
sequence listings	:
tables related thereto	:
(for both, actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (c) below)	
Total number of sheets	: 37

(b) ☐ **only in computer readable form** (Section 801(a)(i))
- (i) ☐ sequence listings
- (ii) ☐ tables related thereto

(c) ☐ **also in computer readable form** (Section 801(a)(ii))
- (i) ☐ sequence listings
- (ii) ☐ tables related thereto

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which are contained the
- ☐ sequence listings: .....
- ☐ tables related thereto: .....

(additional copies to be indicated under items 9(ii) and/or 10(ii), in right column)

This international application is accompanied by the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*: — Number of items

1. ☐ fee calculation sheet :
2. ☐ original separate power of attorney :
3. ☐ original general power of attorney :
4. ☒ copy of general power of attorney; reference number, if any: GPA 02/0021 : 1
5. ☐ statement explaining lack of signature :
6. ☐ priority document(s) identified in Box No. VI as item(s): .....:
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Figure of the drawings which should accompany the abstract: 2

Language of filing of the international application: English

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Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

MALMÖ 28 October 2003

~~AWAPATENT AB~~

Björn Andersson

Authorised Agent

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1.	Date of actual receipt of the purported international application: 28 OCTOBER 2003 (28.10.03)		2. Drawings: ☐ received: ☐ not received:
3.	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4.	Date of timely receipt of the required corrections under PCT Article 11(2):		
5.	International Searching Authority (if two or more are competent): ISA/	6. ☐ Transmittal of search copy delayed until search fee is paid.	

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AUDIO BLOCK

Technical field

The present invention generally relates to mobile telephone equipment, and more specifically to an accessory device for a mobile terminal, which device will affect the performance of the mobile terminal in respect of audio, video, or image processing capabilities provided by the mobile terminal when the accessory device is connected to the telephone.

Background

With the increasing usage of mobile telecommunications stations, such as mobile telephone terminals, by users in various situations and in various places, demands for additional functionality of the mobile terminals arise. Such a demand is e.g. the possibility to be able to place and receive telephone calls to or from other persons without being forced to use one or both hands for operating the mobile terminal. A well known solution to the problem of operating the mobile terminal station without using the hands is to use a hands-free unit which is connected to the telephone by means of contacts on the housing of the mobile terminal and the hands-free unit. The hands-free unit may be in form of a microphone and an earphone coupled to the mobile terminal by means of a thin flexible cable, or in form of a docking station in a car connecting the mobile terminal to a microphone and a loudspeaker when the telephone is placed in the docking station. In addition to the transducer elements the hands-free unit preferably comprises suitable electronic circuitry such as amplifiers and interface circuits. Moreover, the docking station is preferably adapted to interact with the selected parts of the electronics in the car so as to

make it possible to e.g. mute a stereo in the car when a call is received.

Regardless of the specific design of the hands-free unit, it may be operated by means of the voice rather than by means of the hands of the user, wherein the user provides predetermined commands orally to the mobile terminal for instructing the mobile terminal to perform specific tasks. Exemplary commands for use with such a device may be "answer", "hang-up", "call home" etc.

Even though the hands-free facilitates the use of the mobile terminal station while e.g. traveling by car, the environment in which the mobile station is used may not be well suited for oral communication. For example, the noise level in a car varies according to various conditions, such as the vehicle's acceleration and deceleration, entry to and exits from tunnels, the positions of the windows in the car, the character of the road on which the car is traveling, weather conditions, passengers riding in the car, etc. Noise levels exceeding 80 dB inside a car when using the car under normal conditions are common in many cars today. Besides the increased noise level inside the car when the car is moving, the small compartment of the car gives rise to other undesirable acoustic effects, such as echoes and frequency distortion, impairing the intelligibility of a telephone call made from inside the car.

It is known in the art to reduce the impact of echoes generated inside the car by providing suitable electronic equipment which electronically cancels the echoes by means of filtering the signal received by the microphone in the hands-free unit. More specifically, the echo-canceling equipment is usually in form of a digital signal processor (DSP) and an associated echo-canceling software which is executed in the DSP for reducing the influence of the echoes in the signal from the microphone. The algorithm used for modeling the echoes arising from the small compartment inside the car

requires the calculation of a large amount of parameter values which are unique for each compartment.

As can be understood, the accuracy of the calculated parameter values are crucial for the overall performance of the echo canceling equipment, i.e. the conditions under which the audio data, serving as a base for the calculation of the parameter values, are recorded will affect the final values of the parameters in the echo-canceling algorithm. In case the parameter values are based on a recording made while the car is moving, the sources of interference mentioned above (the vehicle's acceleration and deceleration etc) will deteriorate the end result of the parameter value calculation. Moreover, if the compartment is empty apart from the driver of the car, the echo characteristics will be different than if one or more passengers are present inside the car. It is hence of outmost importance that the conditions under which audio data is recorded for the calculation of the parameter values are adapted to the actual driving conditions and that the audio recording in a true manner reflects the design of the interior of the car.

As to the frequency distortion arising from the environment in which the mobile terminal is used, e.g. when using the mobile terminal together with a hands-free unit in a car, the discussion above applies as well. The DSP in the mobile terminal may then perform a frequency correcting algorithm (frequency equalization), wherein frequencies being attenuated by e.g. the car upholstery are amplified in order to provide a higher-quality sound reproduction. Also in this case, the algorithm used for compensating the poor frequency response of the small compartment of the car requires the calculation of filter parameter values which are unique for each compartment.

US 6,097,943 discloses an accessory item for performing echo-canceling in a mobile radio subscriber station. The accessory item includes a separate memory within which parameter values calculated by the processor

of the mobile station and related to performance of the echo-canceling are stored. The parameter values are retrieved by the same or a different mobile station on a subsequent occasion and used to perform the echo-canceling without having to recalculate the parameter values. The parameter values are calculated and stored in the memory of the accessory item on the first occasion when the accessory item is attached to the mobile subscriber station. As can be understood from the above, the invention according to US 6,097,943 put great demands on both the user and the conditions under which the recording is made when he is performing the initial parameter value calculation. Firstly, the user must be provided with specific information regarding the operation of the accessory device, i.e. how the echo-canceling functionality is achieved, in order for being able to provide the correct acoustic conditions for the initial recording. Secondly, the user must take into consideration how to establish the correct acoustic conditions in the car, i.e. shall the car be moving or not, shall there be any passengers present in the compartment, shall the car be in a garage, etc.

Furthermore, the mobile subscriber station to which the accessory item is attached must be able to provide the necessary computational power in order to provide a quick and correct calculation of the parameter values. Hence, in case the accessory device is a hands-free unit the mobile subscriber station must be adapted to receive audio data from the accessory item, use the data for calculating the parameter values and then passing the parameter values back to the hands-free unit.

Summary of the invention

An object of the present invention is to overcome the above described problems of the known technologies in regards to providing the best possible parameter values for media processing performed in a mobile terminal The

present invention is based on the understanding that the parameter values obtained according to the prior art are not optimal due to sources of interference when initially establishing the parameter values.

Particular advantages of the present invention are optimal media processing quality, less demands for high processing capability in the mobile terminal, and easy to use for end users of the mobile terminal. A further advantage of the invention is higher flexibility in selecting the mobile terminal to use with the accessory device.

The above objects, advantages and features together with numerous other objects, advantages and features, which will become evident from the detailed description below, are obtained according to a first aspect of the present invention by an accessory device for a mobile telecommunications terminal, wherein the mobile telecommunications terminal comprises means for media processing and means for connecting to the accessory device, the accessory device comprising:

circuitry adapted to provide media transferring capabilities;

a memory comprising at least one pre-stored parameter value related to the media processing capabilities of the mobile telecommunications terminal and for use by the mobile telecommunications terminal; and

transfer means for transferring the at least one parameter value from the memory in the accessory device to the mobile telecommunications terminal via the connecting means.

The parameter values received in the mobile terminal may hence be optimized for a specific location, thereby providing higher-quality media processing.

The device according to the present invention may be adapted to provide audio, video, or still image

transferring capabilities. The device will hence be suitable for any form of media processing application.

The device according to the present invention may comprise selections means for selecting and transferring at least one pre-stored parameter value from a set of pre-stored parameter values in the memory. A user may hence easily select the best suited parameter value which will provide the best performance of the media processing.

The device according to the present invention may comprise a controller which is adapted to select the at least one pre-stored parameter value from a set of pre-stored parameter values in the memory. The mobile terminal is hence automatically provided with the best suited parameter value without interaction from the user of the mobile terminal.

The device according to the present invention may provide parameter values for an echo-canceling algorithm or a frequency equalizing algorithm.

The above objects, advantages and features together with numerous other objects, advantages and features, which will become evident from the detailed description below, are obtained according to a second aspect of the present invention by a method for providing media processing capabilities for a mobile telecommunications terminal, the method comprising the steps of:

connecting the mobile telecommunications terminal to an accessory device;

receiving in the mobile telecommunications terminal at least one pre-stored parameter value from a memory in the accessory device; and

using the at least one pre-stored parameter value received in the mobile telecommunications terminal for performing media processing on media data in the mobile telecommunications terminal.

In the method according to the invention the media processing may be processing of audio data, video data, or still image data.

In the method according to the invention at least one pre-stored parameter value may be selected from a set of pre-stored parameter values in the memory of the accessory device by means of a switch, or a controller in the accessory device may automatically select the at least one pre-stored parameter value from a set of pre-stored parameter values.

In the method according to the invention, the media processing in the mobile telecommunications terminal may be an echo-canceling algorithm or a frequency equalizing algorithm.

Brief description of the drawings

Further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description in conjunction with the appended drawings.

FIG 1 is a schematic illustration of a telecommunication system, in which the present invention may be applied.

FIG 2 is a schematic block diagram illustrating the mobile terminal and the accessory device in FIG 1.

Fig 3 is a schematic diagram of an echo canceling structure according to the present invention.

Fig 4 illustrates an accessory device according to a first embodiment of the present invention.

Fig 5 illustrates an accessory device according to a second embodiment of the present invention.

Fig 6 illustrates an accessory device according to a third embodiment of the present invention.

Fig 7 illustrates an accessory device according to a fourth embodiment of the present invention.

Fig 8 illustrates an accessory device according to a fifth embodiment of the present invention.

Fig 9 illustrates an accessory device according to a sixth embodiment of the present invention.

Fig 10 illustrates an accessory device according to a seventh embodiment of the present invention.

Detailed description of the invention

A telecommunication system in which the present invention may be applied will first be described with reference to FIG 1. Then, the particulars of the accessory device according to the invention will be described with reference to the remaining FIGs.

In the system of FIG 1, audio, video, or still image data may be communicated between various units 100, 100', 122 and 132 by means of different networks 110, 120 and 130 (in most cases the public switched telephone network 130 is used for audio communication only). In the remainder of the text, the term "media" will be used as a generic term covering any form of audiovisual data. Hence, the media may represent speech, music, video sequences, movies, still images, or any other type of information which may be perceived by a person using his ears or his eyes. Hence, the media may be communicated from a user of a stationary telephone 132 through the public switched telephone network (PSTN) 130 and a mobile telecommunications network 110, via a base station 104 or 104' thereof across a wireless communication link 102 or 102' to a mobile terminal 100 or 100', and vice versa. The mobile terminals 100, 100' may be any commercially available devices for any known mobile telecommunications system, such as GSM, UMTS, D-AMPS or CDMA2000. Moreover, the system includes a computer 122 which is connected to a global data network 120 such as the Internet and is provided with software for IP (Internet Protocol) telephony.

Furthermore, the system of FIG 1 also includes an accessory unit, in this case a hands-free unit 140, which may be connected to any one of the terminals 100, 100',

122 and 132. In the figure the hands-free unit 140 is connected to the mobile terminal 100 for exemplifying purposes only. As will be disclosed in more detail below, the hands-free unit 140 comprises a loudspeaker 141 for reproducing audio data to the user, a microphone 142 for receiving speech or any other audio information, transfer means 143 for adapting the signal levels of the audio data and thereafter transferring the audio data to the mobile terminal 100, a memory 144 for storing parameter values related to the processing of audio data received from the user by means of the microphone 142, and connecting means 145 for connecting the hands-free unit to the mobile terminal.

The system illustrated in FIG 1 serves exemplifying purposes only, and thus various other situations where media is communicated between different units are possible within the scope of the invention.

FIG 2 illustrates a first embodiment of the present invention. A microphone 242 is arranged in, or at least connected to, the hands-free unit 240 in order to pick up sound from the user of the hands-free unit 240 and convert it into electrical signals. It is appreciated that the microphone 242 may be external to the hands-free, i.e. in case the hands-free is an integral part of a car, the microphone may be mounted at a location in the compartment of the car where the sound pick-up from the user is optimal. The microphone 242 is connected to an amplifier 246 in order to adjust the signal level from the microphone 242 so as to optimize the signal-to-noise ratio of the received audio information. The amplified analogue audio signal is then transferred to an interface 243 which in its simplest form is an electrical contact which will be disclosed in more detail below, but preferably comprises electric circuits for protecting the rest of the electric circuitry in the hands-free against electrostatic discharges, or may comprise a transducer for converting the electrical signals from the amplifier

246 into light signals or electromagnetic signals so as to provide wireless transmission of data between the hands-free unit 240 and the mobile terminal 200. The interface 243 is also connected to a second amplifier 247 which amplifies signals received by the hands-free unit 240 from the mobile terminal 200. The amplified signals are then fed to a loudspeaker 241 which is mounted in, or at least connected to, the hands-free unit 240. In case the hands-free unit 240 is an integral part of a car comprising a sound system, the hands-free unit 240 may use the available loudspeakers in the car for reproducing the audio data to the user of the hands-free unit.

The hands-free unit 240 preferably comprises a controller 248 for controlling the performance of the amplifiers 246, 247 and the interface 243. The controller 248 may hence adjust the gain of the amplifiers 246, 247 automatically in response to e.g. the long term sound level in the car. A memory 244 is connected to the controller 248 for storing parameter values related to the function of the accessory device, i.e. in case the accessory device is a hands-free unit 240, the parameter values are preferably FIR-filter coefficients for an echo canceling system or a frequency equalizing system as will be disclosed in more detail below, or the coefficients may be still image or video processing parameters in case the accessory device has still imaging capabilities or video recording capabilities.

A connector 249 is arranged on the housing of the hands-free unit 240 for connecting the hands-free unit 240 to a corresponding connector 201 on the mobile terminal 200. It is noted that the connectors 201, 249 may connect the hands-free unit 240 to the mobile terminal 200 either by means direct galvanic contact or by means of light (e.g. IR) or radio waves (e.g. Bluetooth). In a preferred embodiment the hand-free unit 240 is able to transfer and receive analog audio data, i.e. an interface 202 in the mobile terminal 200 is

arranged with analog-to-digital and digital-to-analog converters for transforming the analog audio data from the hands-free unit 240 into a format suitable for processing in a DSP 203. The controller 248 in the hands-free unit 240 is preferably connected to a controller 204 in the mobile terminal 200 so as to make it possible to transfer pre-stored parameter values from the memory 244 in the hands-free unit 240 via the controller 248 and the interface 243 in the hands-free unit 240 to the DSP 203 in the mobile terminal 200 via the interface 202 and the controller 204 in the mobile terminal 200. The DSP 203 in the mobile terminal 200 may then execute an echo-canceling algorithm on the audio data received from the hands-free unit 240 based on the parameter values received from the memory of the hands-free unit 240. A memory 205 connected to the DSP 203 is used for temporary storage of the parameter values as well as storage of the program code for the echo-canceling algorithm. In addition to or as an alternative to the echo-canceling algorithm, the DSP 203 may execute a frequency equalizing algorithm so as to compensate for frequency distortion caused by the environment in the compartment of the car. A second memory 206 in the mobile terminal 200 is connected to the controller 204 and stores the control program executed by the controller 204 for providing the necessary services to the user (i.e. the operating system and additional applications such as an address book, wireless application protocol (WAP) services, games, etc). The DSP 203 is further connected to RF-circuitry 212 for communication with other units as illustrated in FIG 1.

FIG 3 is a more detailed view of an echo-canceling system 300 according to a preferred embodiment of the present invention. The FIR-filter structure 301 with its associated parameter values 302 is preferably implemented in software by the DSP 203 and its associated memory 205 shown in FIG 2. The FIR-filter structure 301 may however

be implemented in hardware, such as an application specific integrated circuit (ASIC) or a field-programmable gate array (FPGA), without deviating from the scope of the invention. The microphone 242 in the hands-free unit 240 will pick up all sounds in the compartment of the car, including the unwanted feedback from the loudspeaker 241 in the hands-free unit 240. The sound from the loudspeaker 241 reaches the microphone after traveling in many different paths, i.e. directly from the loudspeaker 241 and via reflections in different surfaces in the compartment of the car. As mentioned above, the signal from the microphone 242 is received in the interface 202 in the mobile terminal and is converted from an analog signal to a corresponding digital signal in the analog-to-digital converter 303 so as to make it possible to use the DSP 203 for performing the required signal processing. The audio signal received from other terminals when performing a telephone call and which signal is to be transferred to the hands-free unit 240 is split into two paths where one path leads to the FIR-filter structure 301 and the other path leads to a digital-to-analog converter 304 for providing an analog signal to the hands-free unit 240.

The function of the FIR-filter 301 is to represent a model of the different paths over which the sound may travel in the compartment. In the well-known FIR-filter structure 301, thoroughly described in e.g. "Digital Signal Processing" by John G. Proakis et. al., Prentice Hall International, 1996, ISBN 0133943389, the signal after each delay is multiplied by a parameter value $\gamma_1 - \gamma_n$, and is then added to the other delayed and weighted signals so as to form a filtered output signal. By carefully selecting the parameter values 302 for each branch in the FIR-filter structure 301, the output signal from the filter will be an exact copy of the signal from the loudspeaker 241 including all reflections mentioned above. The filtered signal may then be subtracted from

the composite audio signal provided by the microphone 242 via the A/D converter 303 and hence after the summation point 305 produce a signal that corresponds to the voice of the user of the hands-free unit 240. The signal may then be transferred to the RF-circuitry 305 for transmission to other users of the networks in FIG 1.

FIG 4 illustrates in more detail a hands-free unit 440 according to a first embodiment of the present invention. The hands-free unit 440 in the figure corresponds to the hands-free unit 240 illustrated in FIG 2, but it is emphasized in FIG 4 that the memory 444 comprises pre-stored parameter values that are derived under well established conditions at a production facility. More specifically, the parameter values pre-stored in the memory 444 of the hands-free unit 440 are uniquely derived for a specific car model and its associated compartment. By establishing the parameter values 302 for the FIR-filter structure 301 in a test facility using the specific car model in which the hands-free 440 is to be placed, it is possible to control the environment surrounding the car. It is hence possible to control all interfering noise sources that otherwise would produce less accurate parameter values 302. When establishing the parameter values 302 for the various algorithms that are to be executed by the DSP 203, it is possible to customize the environment in the compartment so as to provide parameter values 302 which gives the best performance of the algorithm. The performance of the echo-canceling algorithm or the frequency equalizing algorithm will hence be significantly improved compared to when the user establishes the parameter values by him self the first time he uses the hands-free unit 440. Additionally, by using pre-stored parameter values 302, the mobile terminal 200 does not need to exhibit high processing capabilities and does not need to calculate the parameter values 302 in an initial session and then transfer them to the hands-free unit 440.

FIG 5 illustrates a second embodiment of a hands-free unit 540 according the present invention. The difference from FIG 4 is that the hands-free unit 540 also comprises a switch 549 by which the user of the hands-free unit 540 may signal to the controller 548 to select different sets of pre-stored parameter values 302 from the memory 544. The selected set of parameter values 302 are then transferred to the FIR-filter structure 301 in the mobile terminal 200 as disclosed above. The user may hence by a simple turn on the switch 549 select the parameter values that gives best performance of the echo-canceling algorithm under the current operating conditions. By selecting the parameter values by means of the switch 549 on the hands-free unit 540 no heavy demands will be put on the mobile terminal 200 as regards processing capabilities and the need to calculate the parameter values 302 in an initial session and then send them to the hands-free unit 540.

FIG 6 illustrates a third embodiment of a hands-free unit 640 according the present invention. In this embodiment the switch is made superfluous by adapting the controller 648 and the amplifier stage 642 so that it is possible for the controller 648 to receive audio data from the microphone 642 indicating the sound level and sound characteristics in the compartment of the car. The audio data is preferably A/D-converted before received in the controller 648 or the controller 648 may comprise an A/D-converter for converting the audio data into a format suitable for processing. The controller 648 may then automatically select pre-determined parameter values 302 for the DSP 203 in the mobile terminal 200 based on a selective algorithm so as to improve the overall sound quality of the hands-free unit 640 and the mobile terminal 200. The controller 648 continuously monitors the sound characteristics in the compartment and use this information in selecting the best suited set of parameter values 302. Various tests of the car under different

operating conditions provide a base for a selection algorithm implemented in the controller 648 for selecting the parameter values 302 to send to the DSP 203, which parameter values 302 will give the best improvement in sound quality, i.e. the controller uses "audio fingerprints" from different situations in making the selection of the set of parameter values 302. As with the previous embodiment, no heavy demands will be put on the mobile terminal 200 as regards processing capabilities and the need to calculate the parameter values 302 in an initial session and then send them to the hands-free unit 640.

FIG 7 illustrates a fourth embodiment of a hands-free unit 740 according to the present invention. As can be seen from the figure the electronic circuitry in the hands-free unit 740 is supplemented with a DSP 749. The DSP 749 is connected to the controller 748 which in turn is connected to the microphone as disclosed in connection with FIG 6. The DSP 749 may of course be connected directly to the microphone 742 via an A/D-converter so as to receive audio data directly from the microphone 742 without passing the data through the controller 748. In the fourth embodiment, the FIR-structure in FIG 3 is supplemented with a least mean square (LMS) algorithm 750 known per se which preferably is implemented in the DSP 749 as shown in the figure. The audio data received from the microphone 742 is A/D-converted 751 and provided to a summing function 752 where the output from the FIR-structure 753 is subtracted from the output from A/D-converter 751. The result from the subtraction is fed to the LMS algorithm 750 which adjusts the parameter values γ of the FIR-filter structure 753 in order to minimize the echoes arising from the small compartment of the car. The optimized parameter values are then transferred to the DSP 203 in the mobile terminal 200 via the controller 748 as disclosed above in order to provide an optimized echo-canceling function in the mobile terminal 200. The

DSP 749 and the LMS algorithm 750 continuously monitors the echoes in the compartment so as to automatically provide optimized parameter values to the DSP 203 in the mobile terminal 200 when the conditions in the compartment are changed due to e.g. the inclusion of an additional passenger in the compartment. It is appreciated that the LMS algorithm 750 may be changed to or supplemented with any other suitable algorithm for performing an automatic optimization of the parameter values used for audio enhancements, such as frequency equalization, in the mobile terminal 200. Consequently, the user of the hands-free unit 740 according to the fourth embodiment of the present invention will always be provided with an optimized set of parameter values from the hands-free unit 740 regardless of changes in the environment in which the user is residing due to e.g. if a person leaves or enters the compartment of the car.

In the embodiments disclosed above the accessory device is embodied as a hands-free unit. It is however appreciated that the accessory device as well may comprise a video camera 842 or a still image camera 842 as shown in a fifth embodiment in FIG 8. A controller 848 is connected to a memory 844 comprising parameter values $\gamma_1 - \gamma_n$ which is used for controlling the contrast, luminance, or saturation of the image signal once it is received in the mobile terminal 200. The process of transferring the parameter values from the memory 844 corresponds to the process of transferring the audio-related parameter values disclosed above. It is hence possible to provide the mobile terminal 200 with optimized parameter values for any specific application which the mobile terminal 200 and the accessory device might be used for.

Figure 9 illustrates a sixth embodiment of a hands-free unit 940 according to the present invention. In this embodiment the DSP 949 receives audio data from the microphone 942 via an A/D converter which may be

integrated with the DSP 949 or implemented as a separate circuit. The DSP also provides the loudspeaker 941 in the hands-free unit 940 with audio data via a D/A converter which also may be integrated in the DSP 949 or provided as a separate circuit. The DSP 949 also receives pre-stored parameter values from a memory 944, which is located in the hands-free unit 940, in order to perform a media processing algorithm, such as an echo canceling algorithm or a frequency equalizing algorithm, on the audio data received from the microphone 942.

An interface 943 receives processed audio data from the DSP 949 and preferably performs a D/A conversion on the received data. The audio data is then transferred to the mobile terminal 200 as disclosed above in connection to FIG 2. The interface 943 also receives audio data from the mobile terminal 200 which data are A/D converted and provided to the DSP 949.

The controller 948 in the hands-free unit 940 is connected to the controller 204 in the mobile terminal 200 via the connector 950 for being able to communicate commands to and from the hands-free unit 940. The controller 948 in the hands-free unit 940 preferably instructs the controller 204 in the mobile terminal to switch off specific media processing functions in the DSP 203 in the mobile terminal 200, which functions are instead provided by the DSP 949 in the hands-free unit 940. The overall performance of the system is hence optimized, since the hands-free unit 940 may be specifically adapted to the environment in which it is to be used. The demands for high-processing capabilities in the mobile terminal 200 are at the same time signify-cantly reduced, since the media processing is performed in the hands-free unit 940.

Figure 10 illustrates a seventh embodiment of a hands-free unit 1040 according to the present invention. This embodiment corresponds to a combination of the sixth embodiment illustrated in FIG 9 and the fourth embodiment

illustrated in FIG 7. Consequently, the DSP 1049 continuously monitors the sound characteristics in the compartment of the car and updates the parameter values in the memory 1044 based on the conditions in the compartment so as to always provide optimized parameter values to the media processing algorithm. The DSP 1049 may use time gaps in the audio data flow, e.g. when the amplitude in the audio channels are low, to update the parameter values. The user of the hands-free unit 1040 will hence take no notice of the small silent period arising from the parameter update.

While the present invention has been particularly shown and described with reference to specific embodiments thereof, it will be understood by those skilled in the art that various changes in form and detail may be made thereto, and that other embodiments of the present invention beyond embodiments specifically described herein may be made or practiced without departing from the spirit and scope of the present invention as limited solely by the appended claims.

CLAIMS

1. An accessory device for a mobile telecommunications terminal, wherein the mobile telecommunications terminal comprises means for media processing and means for connecting to the accessory device, the accessory device comprising:

circuitry adapted to provide media transferring capabilities;

a memory comprising at least one pre-stored parameter value related to the media processing capabilities of the mobile telecommunications terminal and for use by the mobile telecommunications terminal; and

transfer means for transferring the at least one parameter value from the memory in the accessory device to the mobile telecommunications terminal via the connecting means.

2. A device according to claim 1, wherein the circuitry is adapted to provide audio transferring capabilities.

3. A device according to claim 1, wherein the circuitry is adapted to provide video transferring capabilities.

4. A device according to claim 1, wherein the circuitry is adapted to provide still image transferring capabilities.

5. A device according to any of claims 1-4, wherein the device comprises selections means for selecting and transferring at least one pre-stored parameter value from a set of pre-stored parameter values in the memory.

6. A device according to claim 5, wherein the selections means is a switch operable by a user of the accessory device.

7. A device according to claim 5, wherein a controller in the accessory device is adapted to select the at least one pre-stored parameter value from a set of pre-stored parameter values in the memory.

8. A device according to any preceding claim, wherein the media processing in the mobile telecommunications terminal is an echo-canceling algorithm.

9. A device according to any preceding claim, wherein the media processing in the mobile telecommunications terminal is a frequency equalizing algorithm.

10. A method for providing media processing capabilities for a mobile telecommunications terminal, the method comprising the steps of:

connecting the mobile telecommunications terminal to an accessory device;

receiving in the mobile telecommunications terminal at least one pre-stored parameter value from a memory in the accessory device; and

using the at least one pre-stored parameter value received in the mobile telecommunications terminal for performing media processing on media data in the mobile telecommunications terminal.

11. A method according to claim 10, wherein the media processing is the processing of audio data.

12. A method according to claim 10, wherein the media processing is the processing of video data.

13. A method according to claim 10, wherein the media processing is the processing of still image data.

14. A method according to any of claims 10-13, wherein at least one pre-stored parameter value is selected from a set of pre-stored parameter values in the memory of the accessory device.

15. A method according to claim 14, wherein a user of the accessory device selects the at least one pre-stored parameter value from a set of pre-stored parameter values by means of a switch.

16. A method according to claim 14, wherein a controller in the accessory device automatically selects the at least one pre-stored parameter value from a set of pre-stored parameter values.

17. A method according to any of claims 10-16, wherein the media processing in the mobile telecommunications terminal is an echo-canceling algorithm.

18. A method according to any of claims 10-16, wherein the media processing in the mobile telecommunications terminal is a frequency equalizing algorithm.

ABSTRACT

An accessory device for a mobile telecommunications terminal is disclosed, wherein the mobile telecommunications terminal comprises means for media processing and means for connecting to the accessory device. The accessory device comprises circuitry adapted to provide media transferring capabilities, a memory comprising at least one pre-stored parameter value related to the media processing capabilities of the mobile telecommunications terminal and for use by the mobile telecommunications terminal, and transfer means for transferring the at least one parameter value from the memory in the accessory device to the mobile telecommunications terminal via the connecting means.

Elected for publication: Fig 2

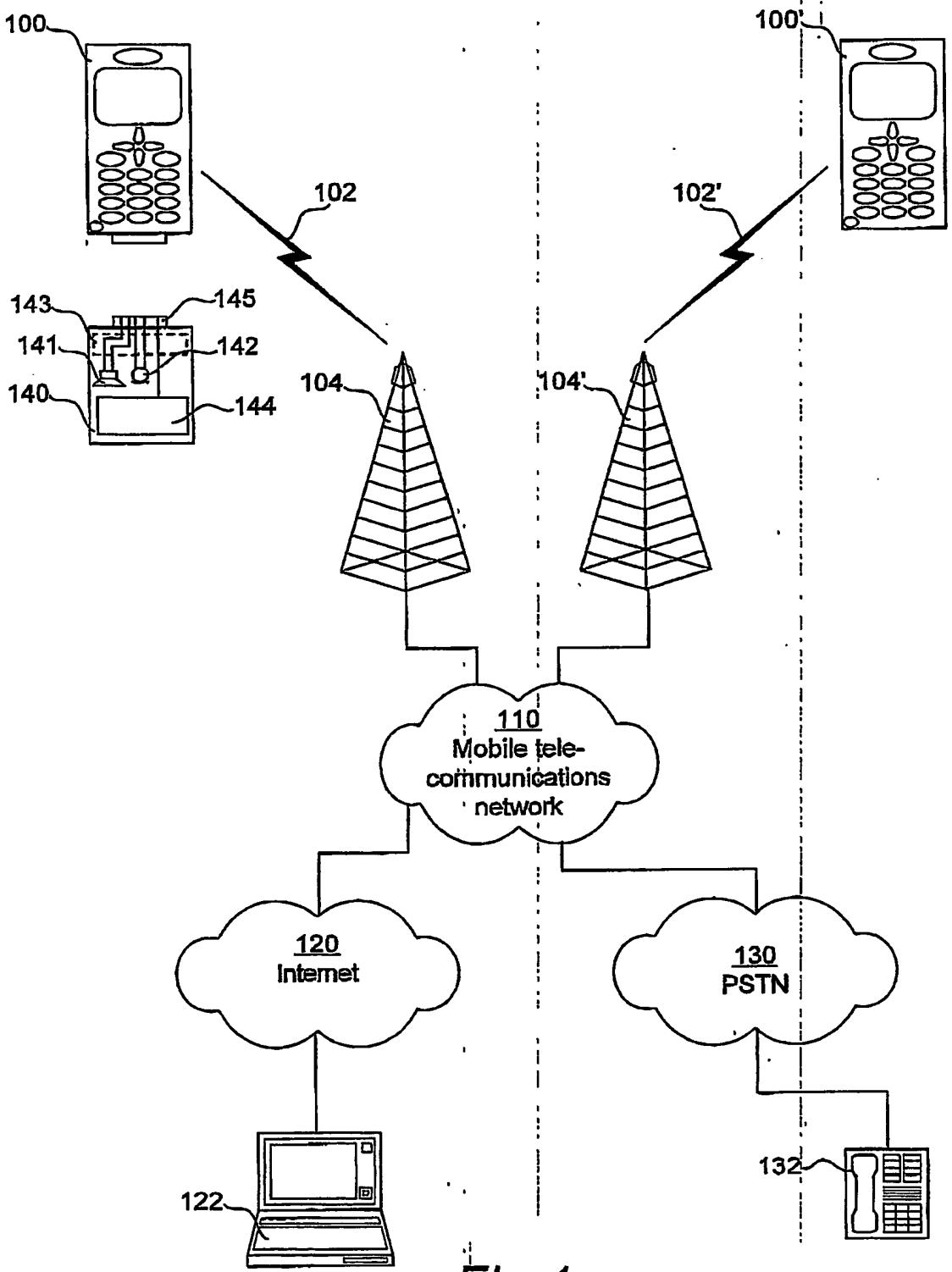
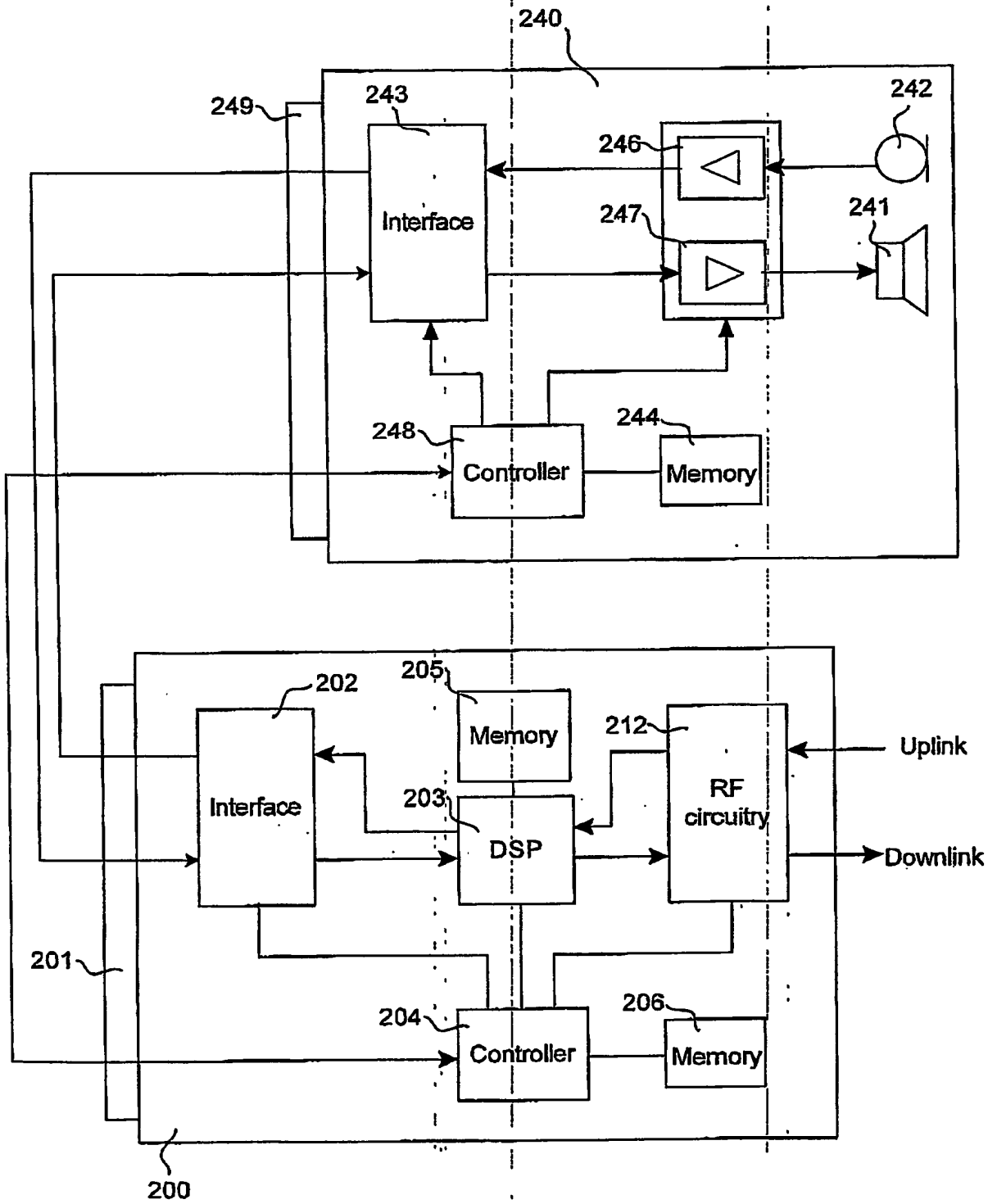

100
100'
102
102'
143
145
141
142
140
144
104
104'
110
Mobile tele-communications network
120
Internet
130
PSTN
122
132

Fig 1


240
249
243
242
246
Interface
247
241
248
244
Controller
Memory
205
202
Memory
212
Uplink
Interface
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RF
circuitry
DSP
Downlink
201
204
206
Controller
Memory
200

Fig 2

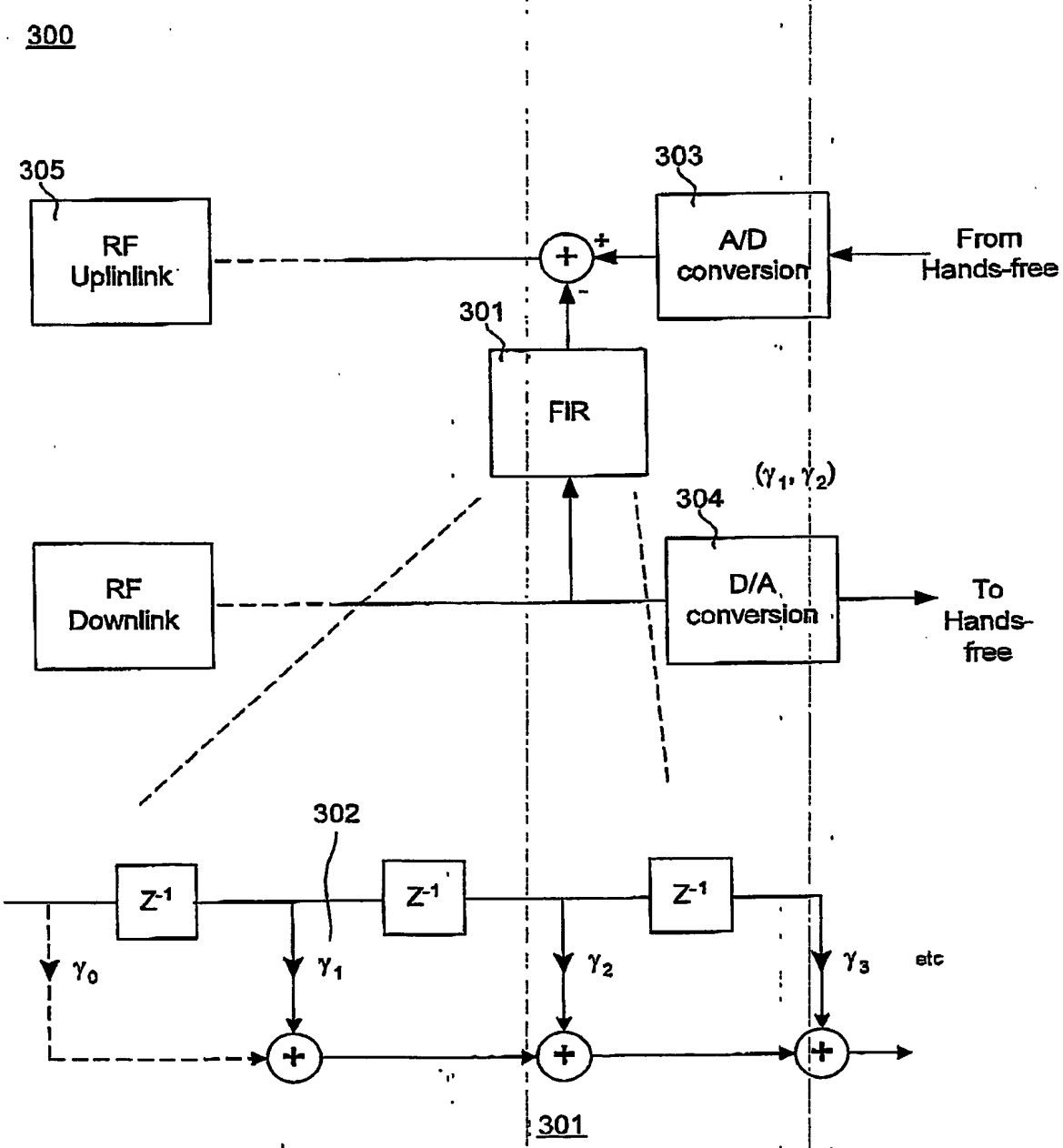

300
305
RF Uplinlink
303
A/D conversion
From Hands-free
+
-
301
FIR
(γ_1, γ_2)
304
RF Downlink
D/A conversion
To Hands-free
302
Z^{-1}
Z^{-1}
Z^{-1}
γ_0
γ_1
γ_2
γ_3
etc
301

Fig 3

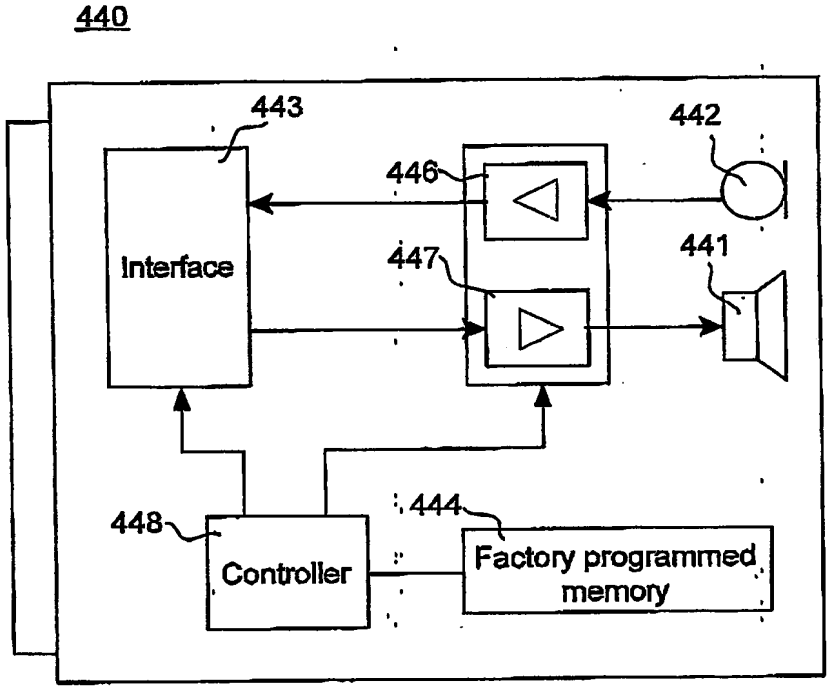

440
443
442
446
Interface
447
441
448
444
Controller
Factory programmed memory

Fig 4

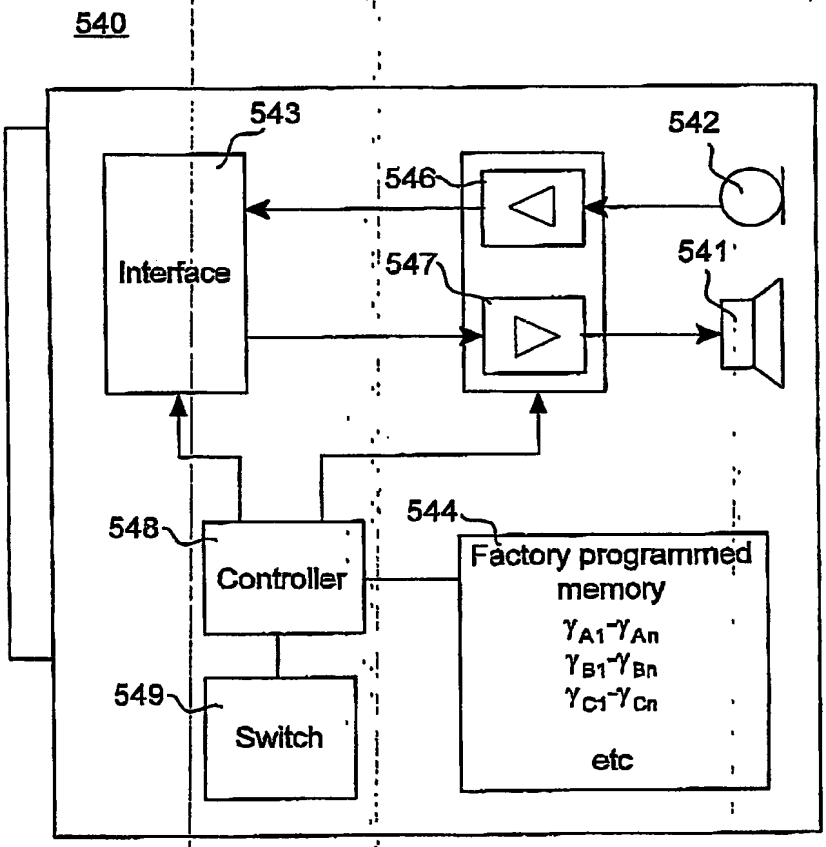

540
543
542
546
Interface
547
541
548
Controller
544
Factory programmed memory
γ_{A1}-γ_{An}
γ_{B1}-γ_{Bn}
γ_{C1}-γ_{Cn}
etc
549
Switch

Fig 5

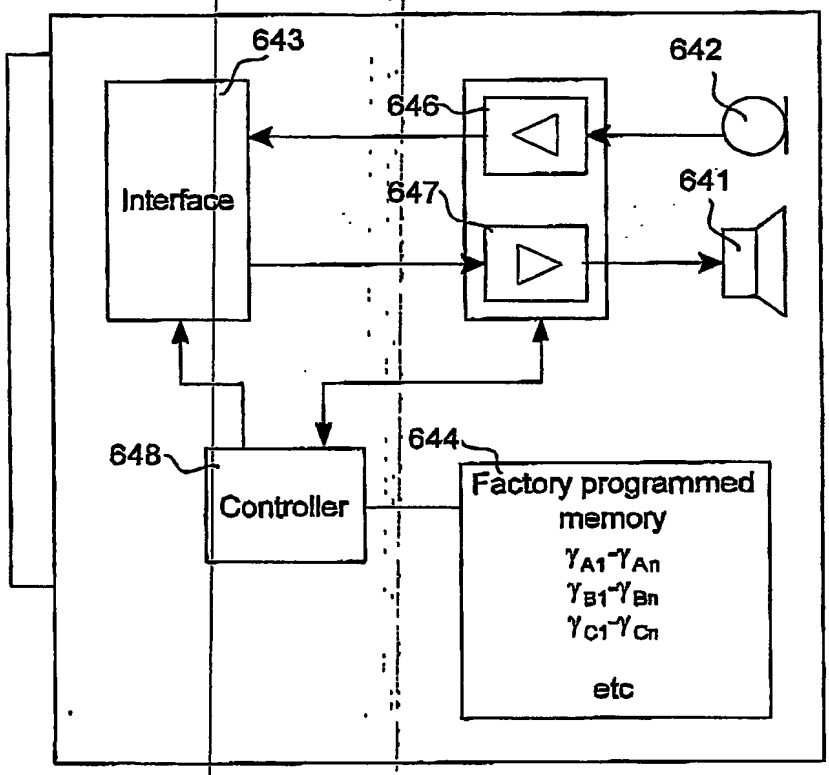
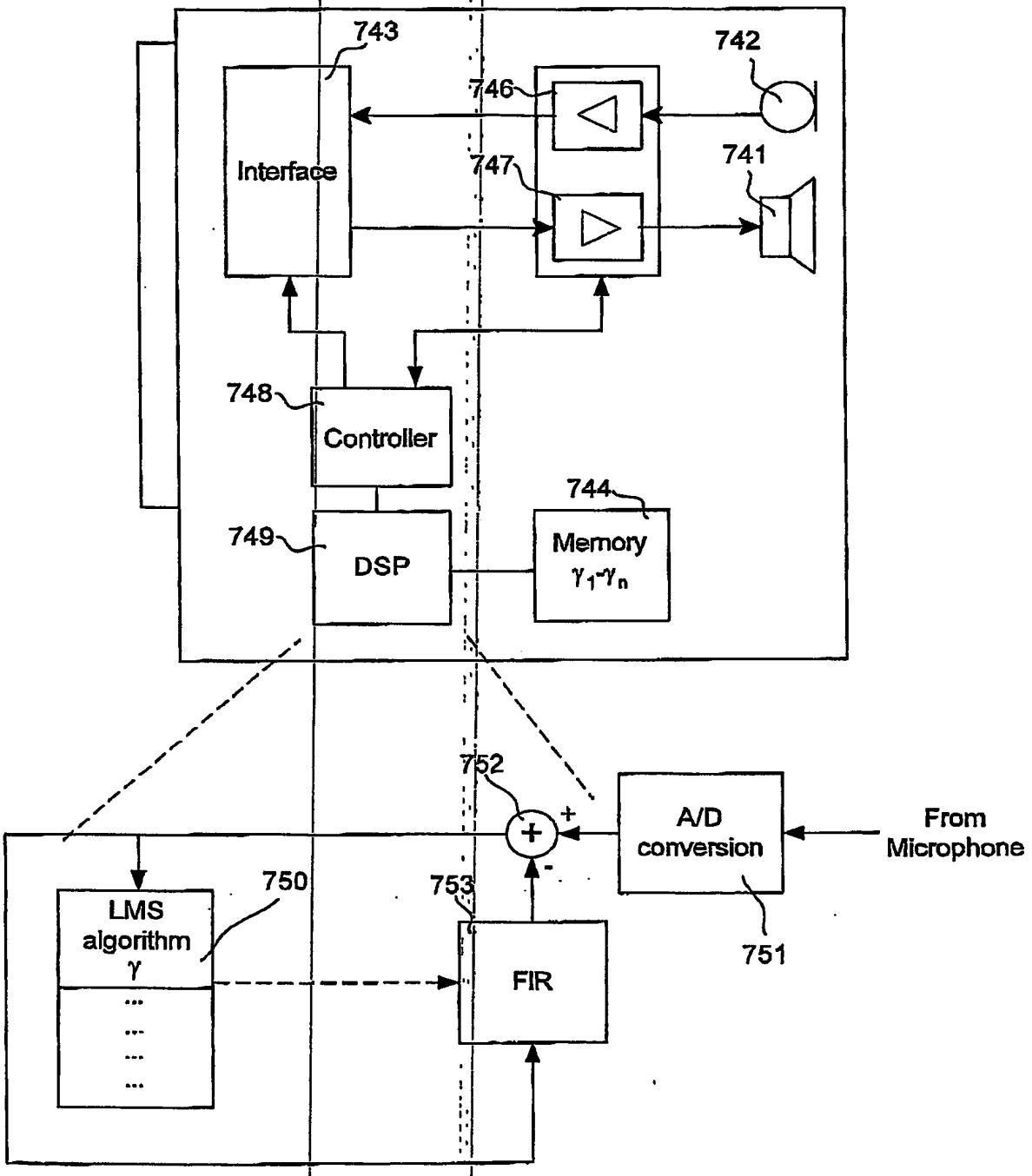

640
643
642
646
Interface
647
641
648
644
Controller
Factory programmed memory
γ_{A1}-γ_{An}
γ_{B1}-γ_{Bn}
γ_{C1}-γ_{Cn}
etc

Fig 6


740
743
742
746
Interface
747
741
748
Controller
744
749
DSP
Memory
γ_1-γ_n
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+
+
-
A/D
conversion
From
Microphone
750
753
LMS
algorithm
γ
FIR
751

Fig 7

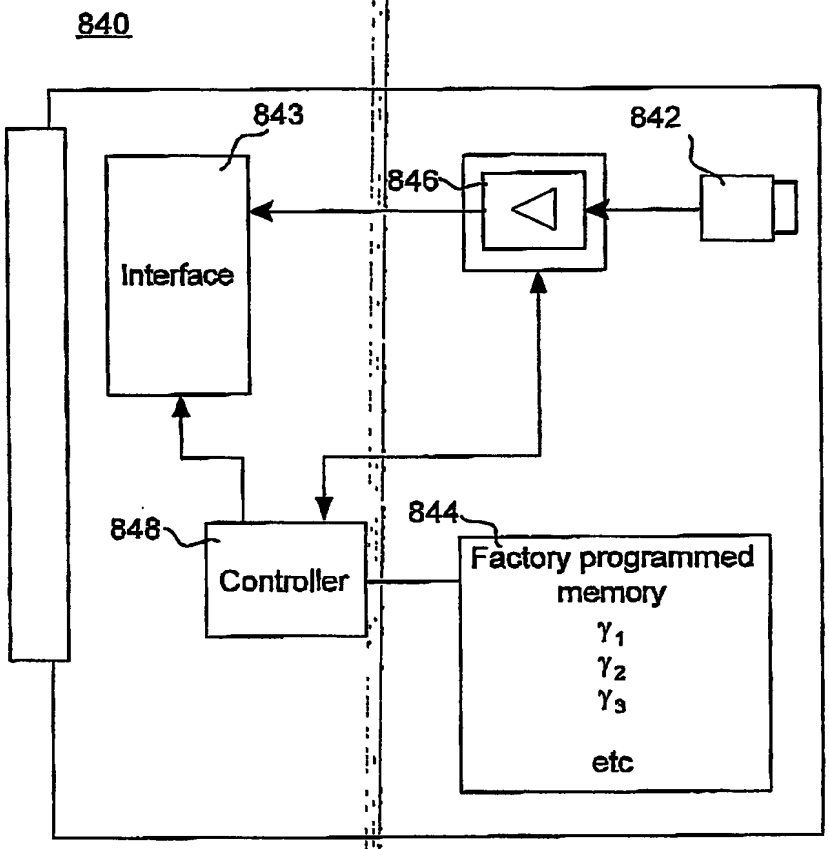
840
843
842
846
Interface
848
Controller
844
Factory programmed memory
γ_1
γ_2
γ_3
etc

Fig 8

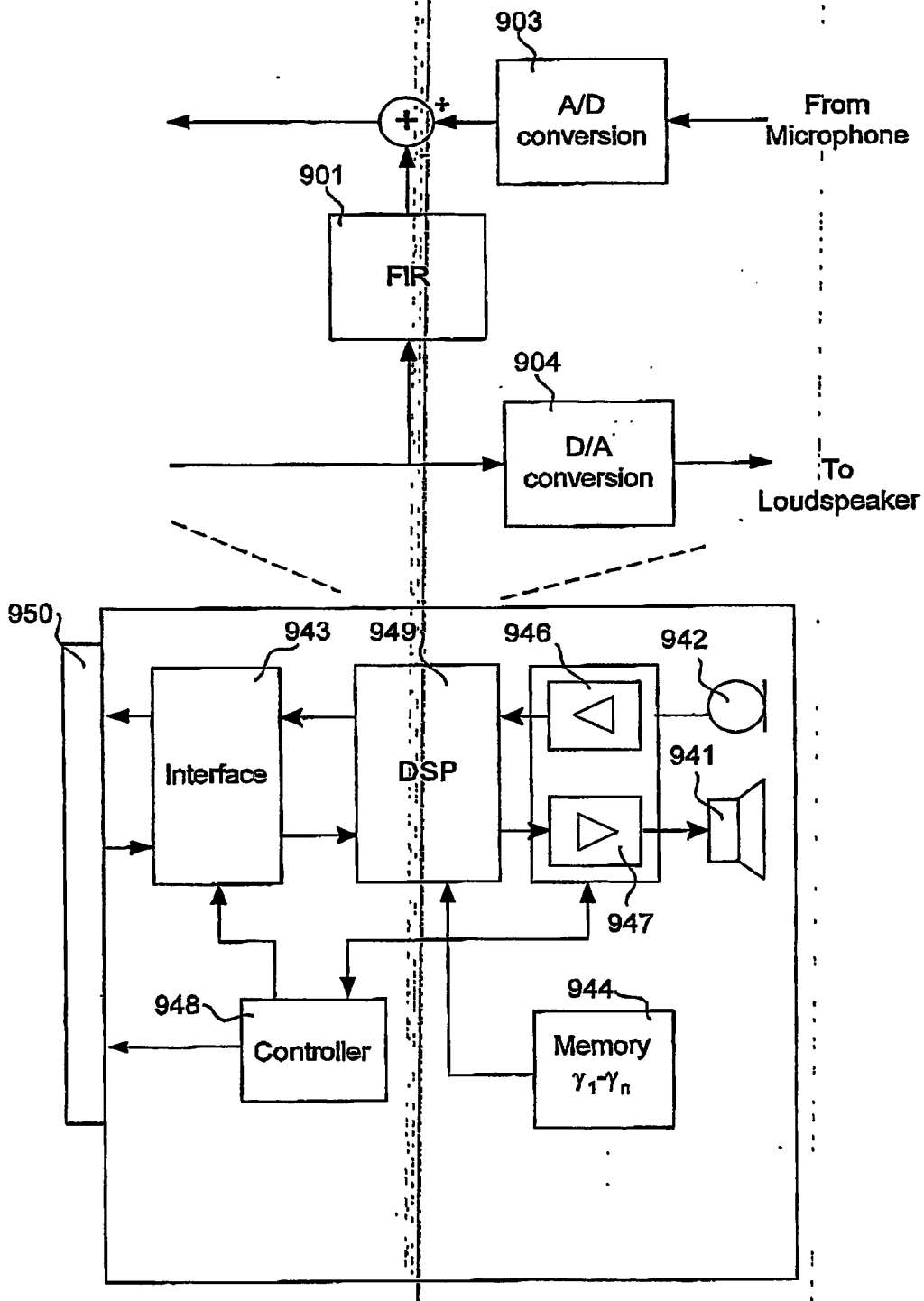
903
A/D conversion
From Microphone
901
FIR
904
D/A conversion
To Loudspeaker
950
943
949
946
942
Interface
DSP
941
947
944
948
Controller
Memory
γ_1-γ_n
940

Fig 9

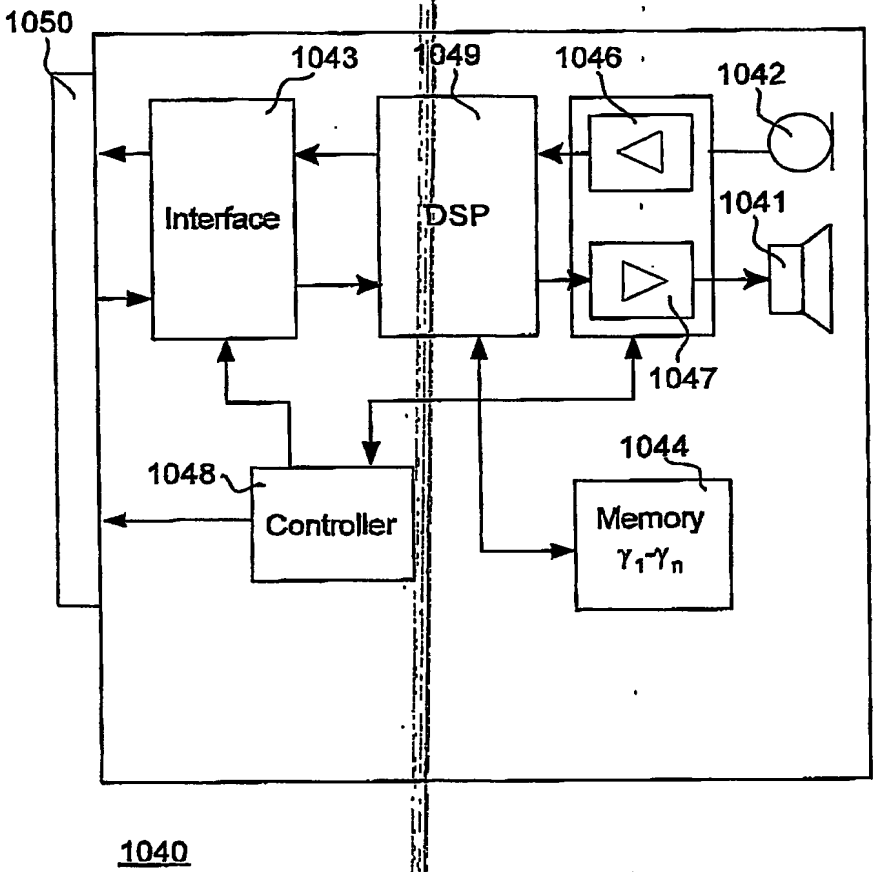
1050
1043
1049
1046
1042
Interface
DSP
1041
1047
1044
1048
Controller
Memory
γ_1-γ_n
1040

Fig 10